SB761
U757
#83-2

United States Department of Agriculture
Forest Service
Southwestern Region

Forest Pest Management Report

R-3 83-2

BIOLOGICAL EVALUATION
Western Spruce Budworm

Carson National Forest
New Mexico

December 1982

LIBRARY
JAN 18 1983
ROCKY MOUNTAIN STATION

3430

R-3 83-2

BIOLOGICAL EVALUATION
Western Spruce Budworm

Carson National Forest
New Mexico

December 1982

USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

PREPARED BY:

T. J. Rogers

T. J. ROGERS, Entomologist
Forest Pest Management

APPROVED BY:

Douglas L. Parker

DOUGLAS L. PARKER
Director of Forest Pest Manangement

ABSTRACT

The western spruce budworm, Choristoneura occidentalis Free., continued to defoliate mixed conifer stands on both divisions of the Carson National Forest, the Taos Pueblo Indian Reservation, and adjoining lands. Total acres of host type defoliated declined from 135,025 in 1981 to 114,450 in 1982. Although defoliation decreased noticeably on the Taos and Questa entomological units, several new areas of defoliation were detected on the Tres Piedras and El Rito entomological units. Budworm defoliation was also detected for the first time in recent years on the Canjilon Ranger District and Jicarilla Apache Indian Reservation.

Average egg mass densities on the Taos and Questa entomological units remained relatively unchanged from those recorded last year. They are still at high levels (17.2 and 26.3, respectively) and indicate that defoliation on both units will continue at levels similar to that of last year. Heavy defoliation will continue to occur along the Rio Fernando de Taos, as well as around Palo Flechado Pass and Osha Mountain on the Taos unit, and along the Red River, Cabresto Creek, and both sides of Hondo Canyon on the Questa unit.

Egg mass densities on the Tres Piedras entomological unit averaged 5.7 in areas treated with carbaryl during the 1982 western spruce budworm suppression project and 15.2 in untreated areas; egg mass densities on the El Rito entomological unit averaged 18.6. These data indicate that defoliation may increase in intensity in all areas not treated on the Tres Piadras unit in 1982 and throughout the infested host type on the El Rito unit in 1983.

The western spruce budworm outbreak is expected to continue on the Carson National Forest, Taos Pueblo Indian Reservation, and adjacent lands of mixed ownership.

Pest management alternatives and recommendations are presented and discussed in this report.

INTRODUCTION

Defoliation to spruce, Douglas-fir, and true firs by the western spruce budworm, Choristoneura occidentalis Free., continued to occur throughout much of the host type in 1982. Visible defoliation[1] was first reported on the Taos and Questa entomological units in 1975 and 1976, respectively. Defoliation was aerially detected on the Tres Piedras[2] and El Rito entomological units in 1980. This year, light and light to moderate defoliation was aerially observed for the first time in recent years on the Canjilon Ranger District and Jicarilla Indian Reservation, respectively. Since 1976, total acres defoliated on the Forest and adjoining lands were 21,760 in 1976, 40,200 in 1977, 15,039 in 1978, 30,542 in 1979, 108,450 in 1980, 135,025 in 1981, and 114,450 in 1982.

Egg mass sample data were collected from the Taos, Questa, Tres Piedras, and El Rito entomological units. These data are summarized in this evaluation. Management alternatives and recommendations are also presented.

TECHNICAL INFORMATION

Insect. Western spruce budworm, Choristoneura occidentalis Freeman

Host. Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
White fir, Abies concolor (Gord. and Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry.

Life History. The western spruce budworm completes one generation each year (Furniss and Carolin 1977).

Stage	Time	Location on host
Egg	August	On needles
Small larvae	Overwinter	In hibernaculum (silken cocoons) on branches and trunk
Large larvae	June	On buds and strobile
Pupae	July	On foliage
Adults	August	In flight

---

[1] Visible defoliation based on the aerial detection survey.
[2] Formerly included the El Rito Ranger District.

Evidence of Infestation

1. Young larvae feeding on newly expanding buds and strobile.
2. Mature larvae consuming current year's needles.
3. Shoots webbed together by larvae.
4. Webbed shoots turning brown and falling from trees.
5. Defoliation most evident in upper crowns of trees.
6. Trees dying from top downward after several years of heavy defoliation.

Extent of Defoliation in 1982. Defoliation was visible from the air on 114,450 acres of the Carson National Forest and adjoining lands. Severity of defoliation was categorized as: Light, 32,175 acres; medium, 41,900 acres; and heavy, 40,375 acres. Defoliation by separate ownerships is as follows:

	L	M	H
Carson National Forest	30,525	36,475	36,475
Taos Pueblo Indian Reservation	750	4,100	2,525
Jicarilla Indian Reservation	250	475	-
Other adjoining land	650	850	1,375

Total acres of visible budworm defoliation decreased subtantially on both the Taos and Questa entomological units in 1982. Defoliation on the Taos unit was light to moderate and occurred mainly along the north and south sides of the Rio Fernando de Taos from Suazo Canyon east to Palo Flechado Pass and along the eastern border of the unit from Palo Flechado Pass to Osha Mountain. Pockets of light to moderate defoliation were also observed around Paradise Park just west of Garcia Park (figure 1). Heaviest defoliation occurred on the Questa unit, particularly along the north and south sides of State Highway 38 from Eagle Rock Lake east to the city of Red River. Severe defoliation also occurred along both sides of Hondo Canyon near the Taos Ski Valley (figure 2).

Several new areas of defoliation occurred on both the Tres Piedras and El Rito entomological units in 1982. On the Tres Piedras entomological unit, areas treated with carbaryl during the 1982 suppression project showed very little defoliation. However, light to moderate defoliation was evident for the first time in the adjacent untreated areas southwest of Tusas Mountain and along the Tusas Ridge south of Cisneros Park (figure 3). On the El Rito unit, budworm defoliation increased significantly (figure 4). Defoliation was moderate to heavy along the northwest boundary of the unit and light to moderate in the newly infested area between the El Rito River on the west and the Rio Vallecitos on the east.

Small pockets of light to moderate budworm defoliation were also detected on the Canjilon District and Jicarilla Apache Indian Reservation (figures 5 and 6).

BIOLOGICAL INFORMATION

Relative Abundance of Pest

Methods. Egg mass surveys were conducted in August to provide an indication of larval densities and subsequent defoliation expected to occur in 1983. Egg mass samples were collected from a total of 80 plots--22 from the Questa and Taos units and 58 from the Tres Piedras and El Rito units. Two branches (70 cm in length) were cut from opposite sides of the midcrown of three sample trees on each plot. Sample trees met the following criteria: Douglas-fir, dominant or codominant; 30 to 50 feet in height; relatively open grown with a full crown; and some budworm feeding evident, but the tree could not be severely defoliated or top-killed. Branches were bagged in ¼-bushel cloth bags, tied, labeled, and transported to the laboratory for examination. All bagged samples were stored in a walk-in cooler set at 40° F.

In the laboratory, the foliage was examined under ultraviolet light for budworm egg masses. Needles bearing egg masses were classed as from current year's foliage, or previous year's foliage, and kept separate in labeled pill boxes. Egg masses were separated as new or old by an experienced laboratory technician. All egg masses on current year's foliage were classed as new, and their characteristics formed the basis for aging egg masses found on previous year's foliage.

Defoliation predictions for 1983 were determined from the density of 1982 egg masses using the following information presented by McKnight et al. (1970):

Egg mass density[a]	Predicted defoliation class[b]
<1.55	Undetectable for all infestations
1.71 to 6.20	Undetectable for "static" infestations Light for "increasing" infestations
9.30 to 31	Light for "static" infestations Moderate for "increasing" infestations
>34.10	Moderate for "static" infestations Heavy for "increasing" infestations

[a] Number of egg masses per square meter of foliage.
[b] Defoliation class limits (percent of new growth).
Undetectable = <5 percent
Light = 5 to 35 percent
Moderate = 35 to 65 percent
Heavy = >65 percent

Results. Results of the 1982 egg mass survey conducted on the Carson National Forest are presented by entomological unit and are sumarized in table 1.

Taos Entomological Unit. This unit includes the Taos Ranger District, Taos Indian Pueblo lands, and adjoining private lands. The overall egg mass density for this unit[3] increased slightly from 14.1 (1981) to 17.2 (1982) egg masses per square meter of foliage. Average egg mass densities for individual sample plots were variable and ranged from 5.5 just east of Jaracito Park (south of Osha Mountain) to 36.6 west of Valle Escondido. The highest egg mass density concentrations were collected from the Capulin Canyon area and along Forest Service Road 437 west of Valle Escondido.

Questa Entomological Unit. This unit includes the Questa Ranger District and adjoining private lands. The average egg mass density for this unit decreased slightly from 31.3 in 1981 to 26.3 in 1982. Although the outbreak on this unit appears to be declining, egg mass densities are still sufficiently high to cause severe defoliation in 1983. Individual plot egg mass densities ranged from 14.6 to 56.4 in Cabresto Canyon and from 9.3 to 17.8 in Hondo Canyon. East of Red River, along the Old Bobcat Pass Trail,[4] budworm egg mass densities averaged 10.0 and ranged from 3.0 to 30.7

Tres Piedras Entomological Unit.[5] This unit includes the Tres Piedras Ranger District, the northeast corner of the El Rito Ranger District from State Highway 110 east to Posos Lake (Kiowa Mountain and immediate surrounding area), and adjoining private lands. Egg mass densities on this unit averaged 5.7 in areas treated with carbaryl during the 1982 western spruce budworm suppression project and 15.2 in untreated areas; the overall average egg mass density for the unit was 6.8. Egg mass densities for individual sample plots were highest southeast of Hopewell Ridge near Rinker Lake, on Tusas Mountain, and along the Tusas Ridge between Cisneros Park and Mule Canyon.

El Rito Entomological Unit.[6] This unit includes the El Rito Ranger District, excluding Kiowa Mountain, and adjoining private lands. Egg mass densities for this unit averaged 18.6 per square meter of foliage and ranged from 3.4 to 38.4. Egg mass densities were highest at plots sampled in Burro Canyon and Canyon del Borracho along the eastern portion of the infestation and along Forest Service Road 406A near Banco Lona and Canovas on the western boundary of the infestation.

---

[3] Egg masses for the Taos entomological unit were collected from the Taos Ranger District.

[4] Area included as part of the 1982 combined western spruce budworm suppression project with the State Departments of Agriculture and Natural Resources.

[5] This entomological unit formerly included the entire El Rito Ranger District.

[6] Formerly was included in the Tres Piedras entomological unit.

Discussion and Prediction of Trend

Western spruce budworm infestations on the Taos and Questa entomological units are expected to decrease again in both intensity and total numbers of acres infested in 1983. Overall, the average egg mass densities on these units remained relatively unchanged from those recorded in 1981; i.e., on the Taos unit, the average egg mass density increased from 14.1 in 1981 to 17.2 in 1982, while on the Questa unit they decreased slightly from 31.3 in 1981 to 26.3 in 1982. These changes are minor and indicate that budworm infestations on these units are "static" or may be declining. According to McKnight et al. (1970), predicted defoliation for new growth would be light in 1983. However, because of the past severity of budworm defoliation and current conditions of the infested stands on these units, even light defoliation will appear severe. Therefore, barring any natural factor(s) that could bring about a complete collapse of the outbreak, defoliation and tree damages will continue to occur along the Rio Fernando de Taos, Palo Flechado Pass, and Osha Mountain on the Taos unit; and along both sides of Red River, Cabresto Creek, and Hondo Canyon on the Questa unit.

Western spruce budworm infestations on both the Tres Piedras and El Rito entomological units are expected to continue at light to moderate levels in 1983. However, because of the recent western spruce budworm suppression project[7] conducted on the Tres Piedras entomological unit in 1982, defoliation on this unit is expected to be less severe. The average egg mass density, as a result of the 1982 suppression project, for the Tres Piedras unit ($\bar{x}$ = 6.8) was significantly lower than that for the El Rito unit ($\bar{x}$ = 18.6), as was intensity and total area defoliated. However, budworm infestations and defoliation on the Tres Piedras unit are expected to continue and will probably increase in all areas that were not treated; i.e., heaviest defoliation is expected to continue between Cisneros Park and Mule Canyon, northeast of Highway 64; and along Spring Creek and Bonito and La Jara Canyons, northwest of Highway 64. Elsewhere, small pockets of defoliation are expected to continue throughout the unit, expecially in drainages that were left untreated because of environmental considerations. On the El Rito entomological unit, budworm infestations and subsequent defoliation are expected to increase throughout the host type in 1983.

MANAGEMENT ALTERNATIVES

No Action. With this approach, the outbreak would be allowed to run its course until a population collapse occurred from a combination of: (a) A lack of foliage to maintain a larval population; (b) unfavorable weather

---

[7] The report, Western Spruce Budworm Suppression Project Using Carbaryl, Carson National Forest, New Mexico, 1982, is being completed.

conditions; (c) heavy predation and parasitism; and (d) a microbial epizootic. Adverse and beneficial effects of the outbreak would have to be accepted. These are:

1. This alternative would not be effective in preventing additional tree damages. Impacts to resource values and uses caused by the budworm would have to be accepted under this alternative. Although damages resulting from the western spruce budworm in the Southwest are not completely known, damages similar to those estimated for the Pacific Northwest could occur if the outbreak continues unabated. These include the following:

Tree damages	Maximum damages (percent)
Growth loss	30
Understory mortality	25
Sawtimber mortality	5
Topkilling	25
Cone crop reduction	90+
Christmas tree use reduction	90+

2. There would be no direct costs associated with selection of this alternative, although timber values will be affected and revenues reduced when severely damaged stands are harvested. Also, the depletion of the understory could necessitate the expenditure of funds for reforestation.

3. Visual qualities and economic and social impacts would continue if this alternative were selected.

Silvicultural Management. The main objective of this alternative is to promote effective timber management of the mixed conifer type to reduce the impact of the western spruce budworm and other forest pests. Thus, stand conditions that reduce tree damages over the long term are created. For example, prescriptions should: (a) Open up stands by logging, thinning, and burning; (b) maintain stand densities favoring ponderosa pine and aspen; (c) favor prescribed burning to reduce the percentage of firs and Engelmann spruce; (d) regenerate stands by artificial means using ponderosa pine stock; (e) favor evenaged stands; and (f) salvage damaged and insect-killed trees.

Effects of this alternative are:

1. The trend of the current outbreak would not be changed if a silvicultural program were initiated. Tree damages would be similar to those listed under the "Maintain Present Management" alternative; however, topkilling and mortality to understory regeneration could be reduced in areas entered during the current outbreak.

2. Visual qualities and economic and social impacts would continue if this alternative were selected.

Direct Suppression. Aerial application of a pesticide registered by the U.S. Environmental Protection Agency (EPA) could be done to suppress all or part of the outbreak on the Forest. However, if only part of the infestation is treated or if adjoining lands are not treated, one or two additional treatments may be required during the infestation cycle since treated stands could be reinfested from nearby untreated areas.

Application would be carefully timed to the development of the larvae and bud flush; i.e., when 20 percent of the larvae are in the fifth and sixth instars and buds are 85 to 90 percent flushed. This would insure maximum effectiveness with a minimum dosage of insecticide. An application of this type is designed to utilize indigenous natural control agents to further reduce and maintain the budworm population at a low level.

Effects of this alternative are:

1. If a direct suppression program were to be carried out on the Forest in 1983, tree damages and losses could be reduced in areas where permanent tree damages have not yet occurred. However, once permanent tree damages have occurred, the direct suppression alternative may no longer be practical.

2. Although there would be immediate costs associated with the application of a pesticide, about $10 per acre positive benefits could be achieved by preventing additional effects to timber and recreational activities.

3. Adverse environmental effects resulting from the application of a pesticide would be minimal and temporary.

Insecticides registered for use against the budworm follow:

1. Carbaryl (carbamate insecticide)

The Sevin 4 oil formulation of carbaryl has given consistently satisfactory results in suppressing budworm outbreaks throughout the West. An outbreak on the Santa Fe National Forest, New Mexico, was successfully suppressed in 1977, and the outbreak has remained at a low level for 5 years (Telfer, Ragenovich, and Rogers 1982). Carbaryl is a nonpersistent pesticide which is available for general use. One pound of active ingredient per acre is the registered dosage rate, and no lasting environmental effects have been identified at this application rate.

2. Acephate (organophosphate insecticide)

Orthene is a nonpersistent insecticide registered for use against the western spruce budworm and other forest defoliators. Although this insecticide has been shown to be effective against the budworm, it has never been used in the Southwest.

3. Malathion (organophosphate insecticide)

Malathion is a nonpersistent, broad-spectrum insecticide, registered for use against more than 100 insects, including the western spruce budworm. However, it is not recommended because it has yielded inconsistent results in suppressing outbreaks.

4. Microbial Insecticides

Microbial insecticides such as Bacillus thuringiensis Berliner (B.t.), a bacterium, and viruses need further testing and field evaluation before they are ready for use. In 1981, two B.t. formulations were pilot tested by the USDA Forest Service and New Mexico Departments of Agriculture and Nautral Resources near Eagle Nest, New Mexico. Preliminary results show that larval mortality was greater in sprayed areas than in check blocks. If treatment is necessary, B.t. could be used in sensitive areas, such as along waterways and near lakes, and near specific wildlife areas, etc.

Treatment of High-Value Trees. In recreation areas, VIS centers, and other areas where defoliation of high-value trees would be unacceptable, individual or small groups of budworm-infested trees could be treated by a ground application of an EPA-registered insecticide to reduce the larval density and prevent the adverse effects of defoliation.

Effects of this alternative are:

1. Because only selected high-value trees within an infestation would be treated, this would require annual applications during the outbreak cycle, since treated trees would be reinfested from the nearby infestation.

2. Application costs associated with this alternative would have to be accepted.

3. Adverse environmental effects would be minimal and temporary.

RECOMMENDATIONS

Management of Western Spruce Budworm Outbreaks

1. Short-term Pest Management. Direct suppression of the entire outbreak on either the Taos or Questa entomological units is not recommended. Based on current information, it appears that this alternative is no longer practical or economically sound since permanent tree damages have already occurred. However, a partial treatment program to treat high-value trees is recommended where recreational and esthetic values must be preserved and/or where management objectives are threatened. Such areas should be examined on an individual basis to determine if suppression would be effective this late into the infestation cycle. It must also be realized that partial treatment may only be effective for a short period of time, possibly 2 years. A combination of chemical pesticides and B.t. is

recommended for use if a partial treatment program is implemented. The majority of the areas warranting treatment should be treated with chemical pesticides and sensitive areas with B.t.

Direct suppression is recommended for infestations on the Tres Piedras entomological unit not previously treated in 1982 and for infestations on the El Rito entomological unit. Infestations on these units are relatively new and permanent tree damages have not yet occurred; however, permanent tree damages could occur within a year or two if the infestations continue at present or increased levels. Once permanent tree damages occur, direct suppression may no longer be a viable alternative and all damages occurring would have to be accepted. Also, direct suppression of areas not previously treated on the Tres Piedras unit would maintain the integrity of areas previously treated and further reduce the possibility of population buildups from adjacent untreated areas. As with partial treatment, the majority of the infested areas should be treated with chemical pesticides and sensitive areas with B.t.

2. Long-term Pest Manangement. Long-term silvicultural management for western spruce budworm on all entomological units can be accomplished by including pest management considerations into existing and future timber and fire management programs. For example, these management programs should facilitate the removal of susceptible old growth and favor ponderosa pine, Douglas-fir, and aspen in vigorous, even-aged mixed conifer stands. These stands should be noncontiguous and evenly distributed by age class.

No recommendations have been made for the Taos Indian Pueblo lands or the Jicarilla Apache Indian Reservation.

REFERENCES

Furniss, R. L., and V. M. Carolin. 1977. Western forest insects. USDA Forest Serv. Misc. Publ. No. 1339. 654 pp.

McKnight, M. E., J. F. Chansler, D. B. Cahill, and H. W. Flake, Jr. 1970. Sequential plan for western spruce budworm egg mass surveys in the central and southern Rocky Mountains. USDA Forest Serv. Res. Note RM-174. 5 pp.

Telfer, William G., Iral R Ragnovich, and T. J. Rogers. 1982. Western spruce budworm suppression project using carbaryl-1977. USDA Forest Serv. Progess Rep. No. 5. R-3 82-7. 17 pp.

TABLE 1.--Summary of the egg mass and aerial detection surveys on the Taos, Questa, Tres Piedras, and El Rito entomological units

Taos entomological unit		1976	1977	1978	1979	1980	1981	1982
New egg masses/ square m foliage		38.3	22.3	36.3	42.8	50.6	14.1	17.2
Egg mass density ratio[a]		1.7:1	0.6:1	1.6:1	1.2:1	1.2:1	0.3:1	1.2:1
Actual defoliation[b] (acres)	L	9,400	15,040	2,725	6,477	31,200	6,375	7,175
	M	6,600	10,800	2,790	9,191	26,750	41,125	18,550
	H	560	0	4,250	282	6,975	15,775	3,375
	TOTAL	16,560	25,840	9,765	15,950	64,925	63,275	29,100

Questa entomological unit								
New egg masses/ square m foliage			9.9	17.9	43.1	47.6	31.3	26.3
Egg mass density ratio[a]			3.4:1	1.7:1	2.4:1	1.1:1	0.7:1	0.8:1
Actual defoliation[b] (acres)	L	1,900	13,080	2,560	3,174	22,850	4,800	2,025
	M	300	960	2,330	5,197	15,550	39,700	8,550
	H	0	320	384	6,221	3,275	18,550	36,400
	TOTAL	2,200	14,360	5,274	14,592	41,675	63,050	46,975

Tres Piedras entomological unit		1980[c]	1981[d]	1982
New egg masses/ square m foliage		1.8	35.0	6.8
Egg mass density ratio[a]			19.4:1	0.2:1
Actual defoliation[b] (acres)	L	550	5,650	2,625
	M	0	50	1,725
	H	0	0	0
	TOTAL	550	5,700	4,350

TABLE 1 (continued)

El Rito Entomological Unit		1980[c]	1981[b]	1982[c]
New egg mass/ square m foliage		29.7	33.5	18.6
Egg mass density Ratio[a]			1.1:1	0.5:1
Actual defoliation[b] (acres)	L	325	1,700	20,275
	M	900	1,100	13,075
	H	75	200	600
	TOTAL	1,300	3,000	33,950

[a] Egg mass density ratio is the ratio of new egg masses in the survey year to new egg masses of the previous year.
[b] Actual defoliation as determined from aerial detection survey, L = light, M = moderate, H = heavy.
[c] Data obtained from report R-3 81-4.
[d] Data previously combined under Tres Piedras entomological unit in 1981.

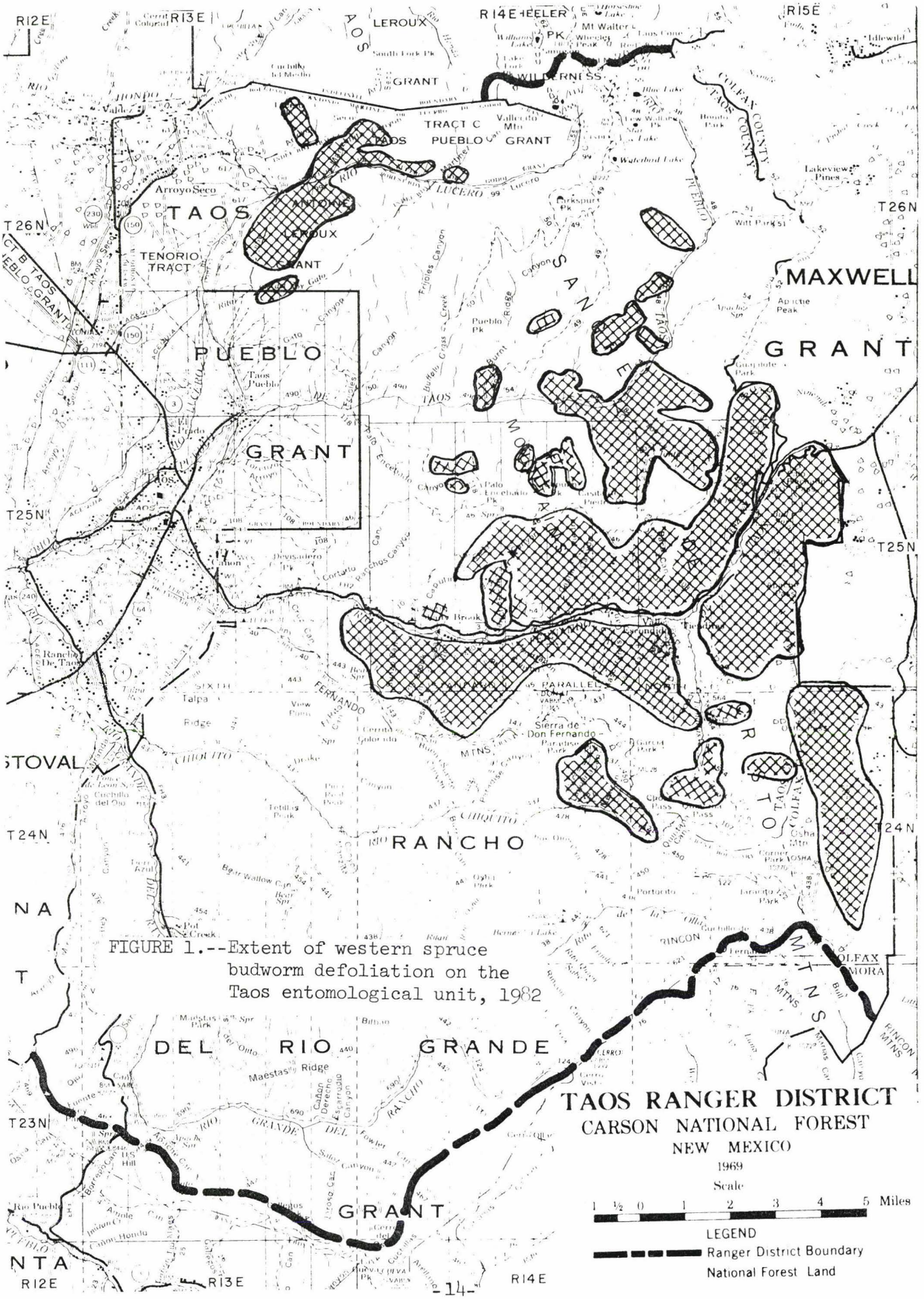

FIGURE 1.--Extent of western spruce budworm defoliation on the Taos entomological unit, 1982

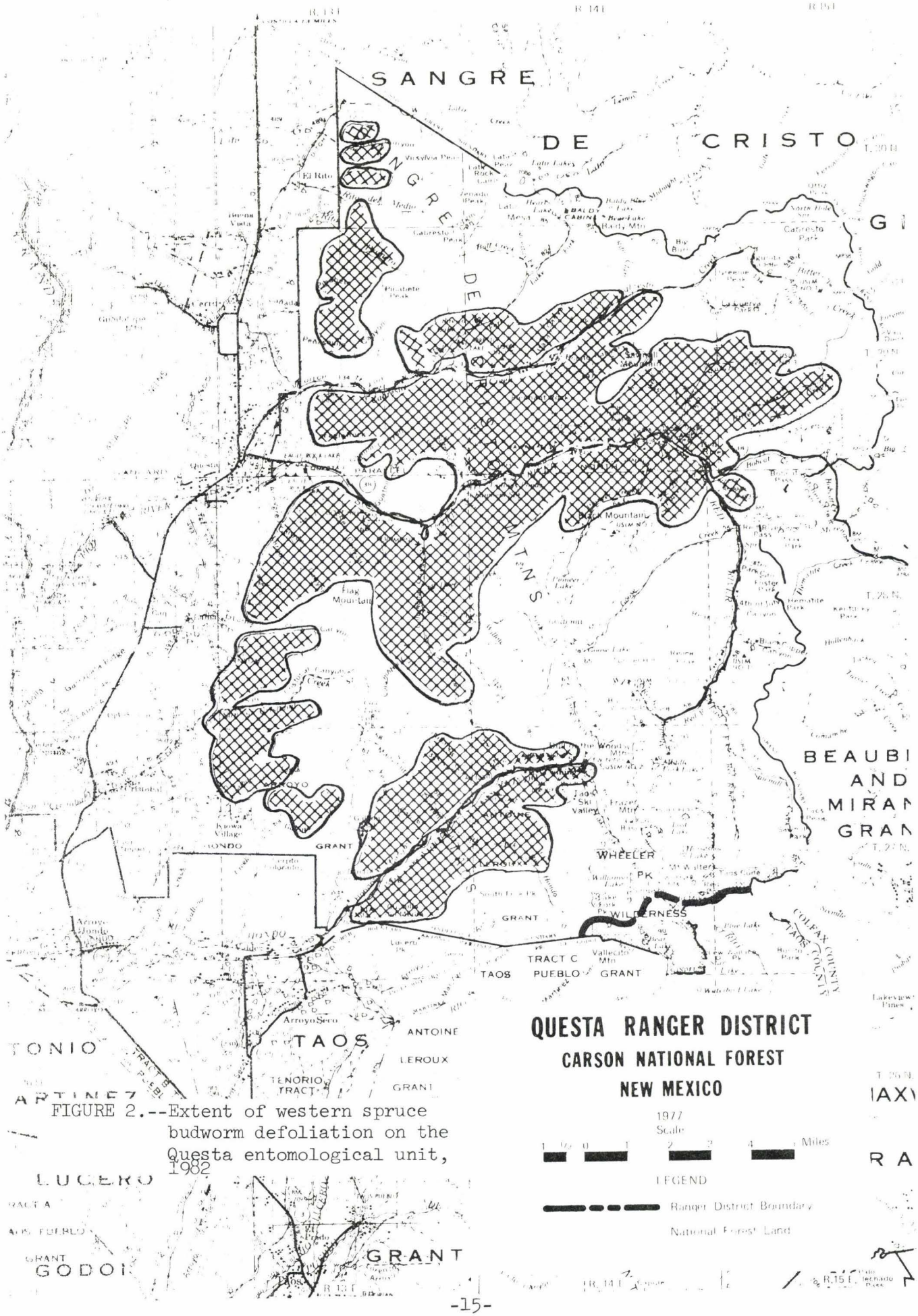

FIGURE 2.--Extent of western spruce budworm defoliation on the Questa entomological unit, 1982

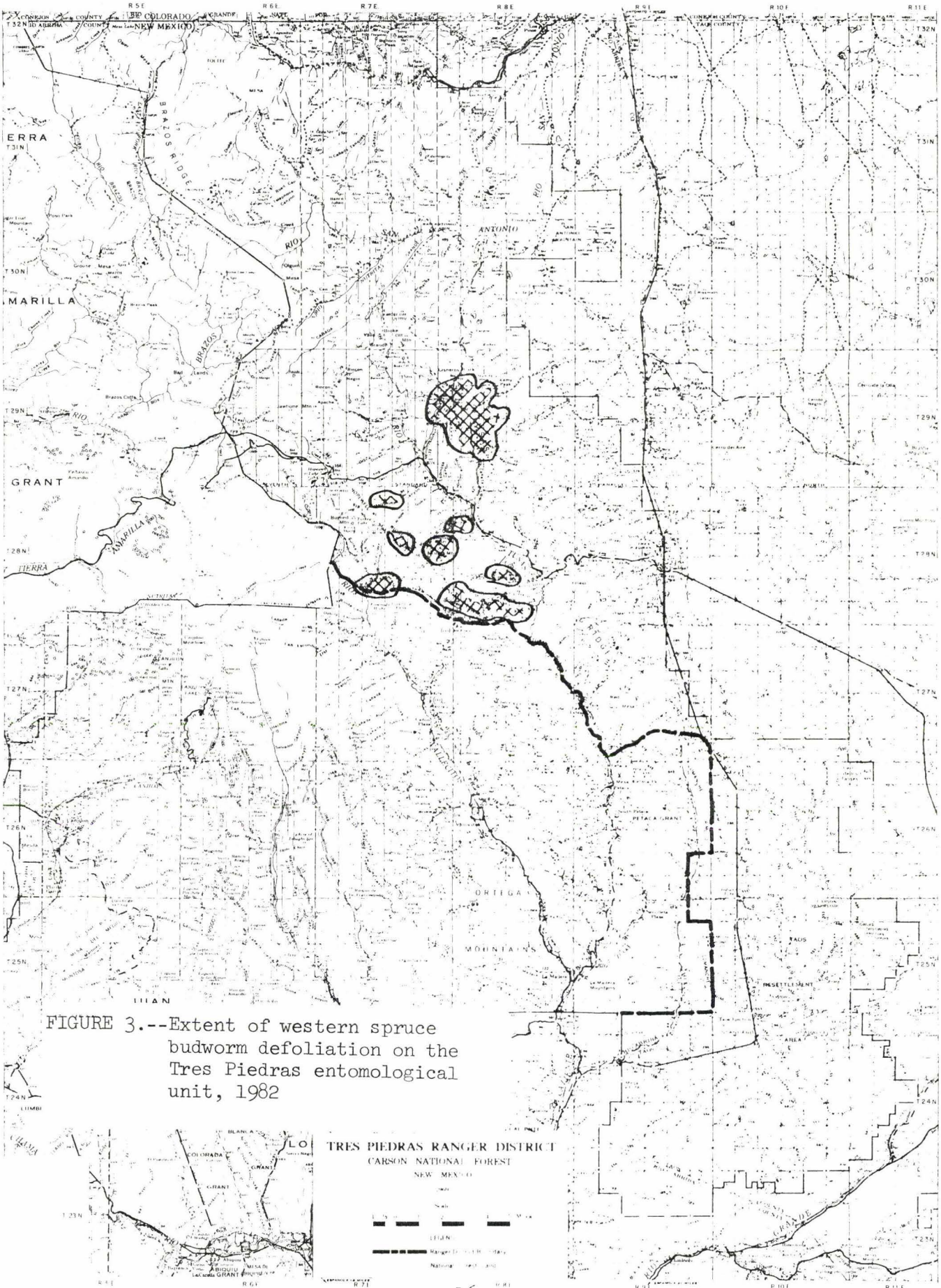

FIGURE 3.--Extent of western spruce budworm defoliation on the Tres Piedras entomological unit, 1982

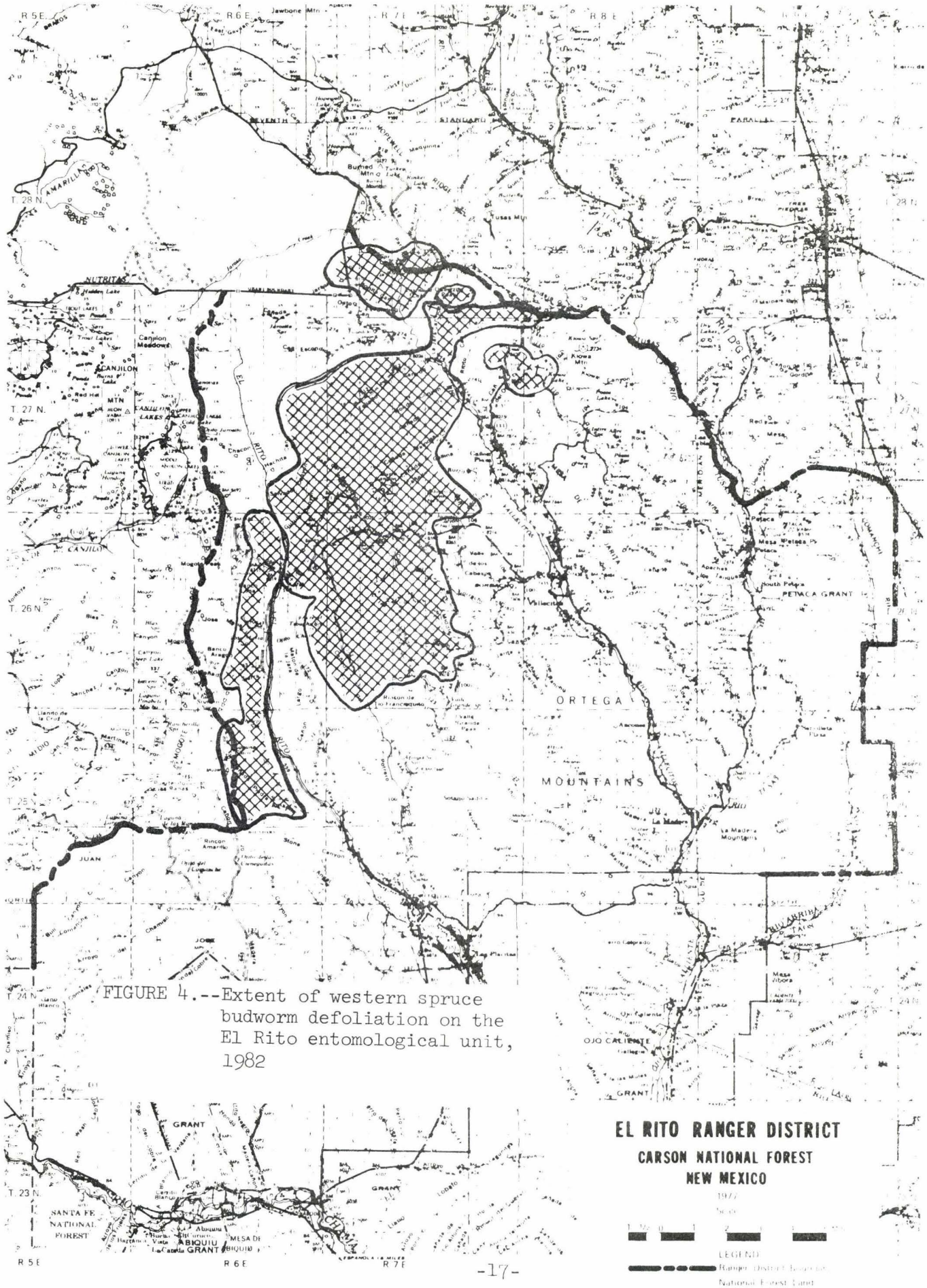

FIGURE 4.--Extent of western spruce budworm defoliation on the El Rito entomological unit, 1982

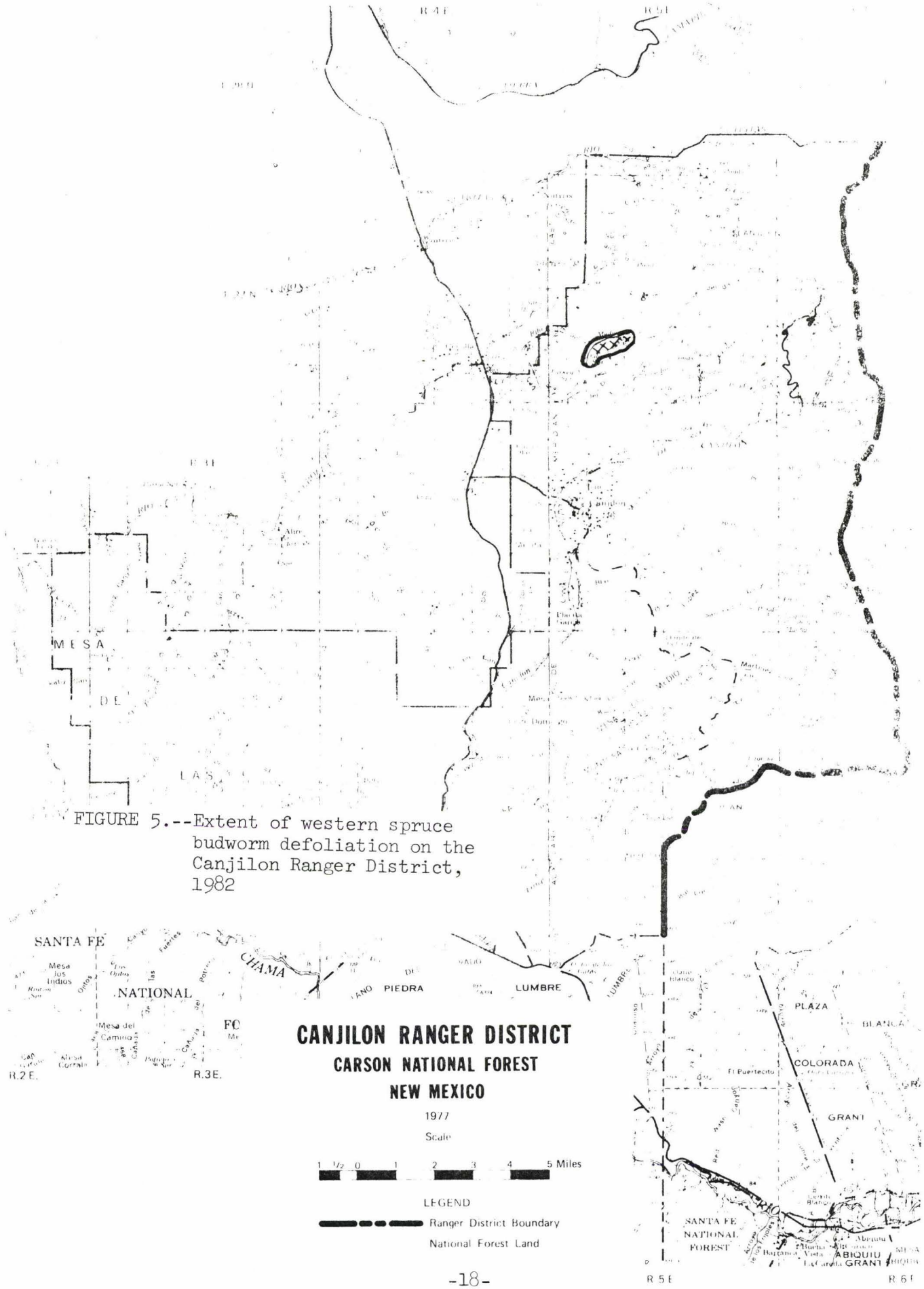

FIGURE 5.--Extent of western spruce budworm defoliation on the Canjilon Ranger District, 1982

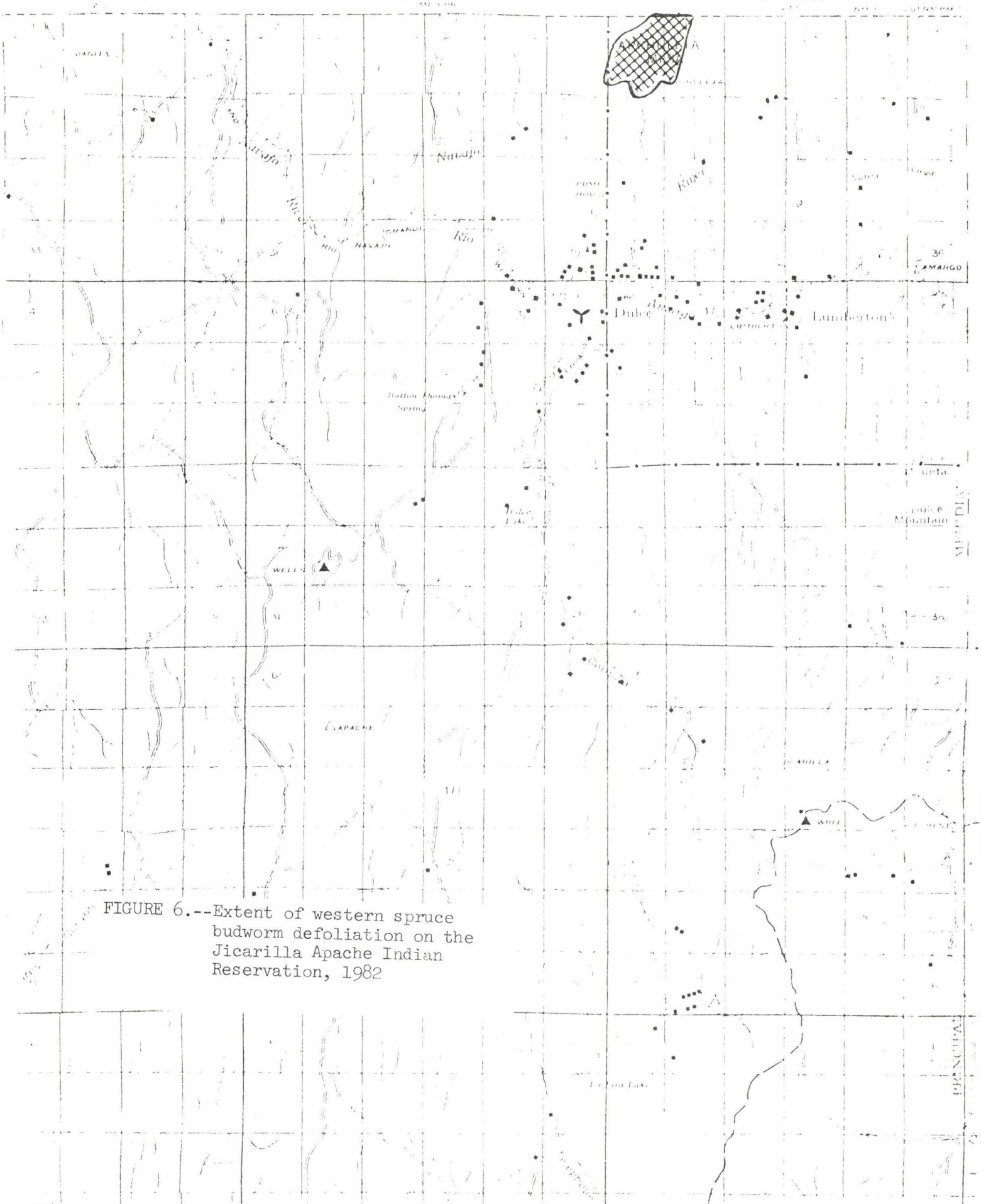

FIGURE 6.--Extent of western spruce budworm defoliation on the Jicarilla Apache Indian Reservation, 1982